



mRPC Test Lab Safety System Blue Sheet Certification Test Procedure

procedure name

PHENIX Procedure No. PP-2.5.5.6-12

Revision: A

Date: 05/17/13

Hand Processed Changes

HPC No.


Date

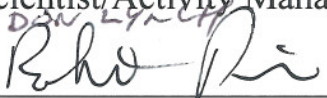
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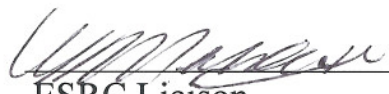
- Typo: On the Revision Control Sheet, the "Approved By" column is blank. It should have 4 names on it, since this procedure was signed by 4 people.*
- Typo: Under Appendices, A), it mentions two sheets. There is only one sheet in Appendix A*
- Typo: In Appendix A, Proc. No. PP-2.5.5.6-10 should be deleted or changed to PP-2.5.5.6-12*

Approvals

 5/29/13
PHENIX Cognizant Engineer/ Date
Scientist/Activity Manager

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Approvals

PHENIX Cognizant Engineer/ Date
Scientist/Activity Manager

PHENIX Cognizant Engineer/ Date
Scientist/Activity Manager

PHENIX Cognizant Engineer/ Date
Scientist/Activity Manager

ESRC Liaison Date

REVISION CONTROL SHEET

LETTER	DESCRIPTION	DATE	AUTHOR	APPROVED BY	CURRENT OVERSIGHT
A	First Issue (Based on similar Procedure for RPC Factory (PP-2.5.5.6-10)	5/17/2013	P. Giannotti		P. Giannotti
		•			

mRPC Safety System Blue Sheet Certification Test Procedure

1.0 General System Description of Operation

The mRPC Facility Safety System monitors conditions inside & outside the tented structure and, upon detection of **major** safety faults, will cause interruption of the 208 volt and 120 volt AC power distribution network inside the tent. Additionally, the major faults will cause the mRPC gas supply (solenoid operated) valves to close, thereby terminating gas flow into the detector chambers under production & test inside the tent. The system will also detect **minor** alarm conditions. The major & minor alarms will be transmitted to pre-assigned alarm response personnel and/or system experts in the form of pre-recorded messages and received on cell/home phones or BNL phones in the MCR, CAS Watch Station or PCR.

The following **major** safety faults will trip electric power and close the three gas valves supplying Isobutane, Sulfurhexafluoride, and Freon (R134A) gasses.

- 1) **High level smoke sensed inside the tent.** (BNL Fire/Rescue Group response)
- 2) **Flammable gas high level sensed inside or outside the tent.** (CAS Watch response)
- 3) **Emergency stop (crash) push button stations inside or outside the tent.**

The following **major** safety fault will not trip electric power, however, it will close the three gas valves:

- 1) **SF6 gas high level sensed inside or outside the tent.** (CAS Watch response)

The following **major** safety faults will cause evacuation horns/strobe lights to report at locations inside and outside the mRPC Tent:

- 1) SF6 gas high level – BLUE color strobe lens.
- 2) Flammable gas high level – YELLOW color strobe lens.

The following **minor** safety faults will only send a phone alarm message:

- 1) **Flammable gas monitor low level alarm or malfunction.**
- 2) **SF6 gas monitor low level alarm or malfunction.**

The smoke alarm zone is monitored by the BNL FIRE Rescue Group and a zone trip will cause emergency personnel & equipment to respond at the mRPC facility.

Design Philosophy

The mRPC Safety System is designed around individual trip channels consisting of 24 volt DC relay latching circuits. Each of the trip channels receive a dry contact input originating at the monitoring instrument's contact output (gas monitors, fire alarm panel, crash buttons).

Under normal conditions the monitor's output contact is closed and the trip channel's relay is latched ON (energized). An abnormal condition will cause the contact to open, unlatch (de-energize) the relay and the protective action will be initiated. Any broken wires, loose connections, or loss of control power to the relay logic or safety instruments will cause the trip relays to de-energize. This design philosophy is therefore considered "Fail-Safe".

Some trip relays are connected into a relay logic "AND" circuit which controls the 480 volt main contactor feeding power into the 480/208/120 volt transformer. The main transformer's secondary winding connects to the mRPC Tent power distribution breaker panel. All trip channels must be satisfied normal in order to manually reset (latch ON) the main contactor or re-open the gas valves.

The mRPC Safety System is modeled after the PHENIX Safety System and functions similarly.

Controls and Indicators

The Safety System input/output controls with visual indicators are contained in a single electronics rack (mRPC-SS-R) (78" high x 24" wide x 36" deep). The rack is located outside the tent near its south east corner.

The rack front panel displays the four major fault conditions via flashing red illuminated push buttons (trip resets). The total number of red push button lights is six (two are spare trip channels for future use, if needed). A major fault condition will also cause the Trip Signal Reset push button to illuminate.

An illuminated knob operated switch allows the system expert to restore the mRPC tent power following a trip and only after the faults are first investigated, cleared from the detection instruments & manually reset from the front panel (in that order). This switch directly controls the 200 amp 480 volt AC main power contactor which is located on the high bay north wall. A power OFF position is not provided on the switch. The only way to trip OFF the main contactor is through the safety channel inputs. The easiest way to do this is through the crash push buttons (channel 4).

The major faults will also cause the rack alarm horn to report and be heard in the high bay vicinity. The horn can be silenced via an "alarm silence" pushbutton on the rack. Additionally, personnel evacuation alarm horn/strobe lights will turn on for the conditions of high flammable gas (Yellow color) and high level SF₆ gas (Blue color). The evacuation horns/lights will also be turned off via the silence button.

Gas Valves

There are three 24 volt DC (de-energize, fail closed) solenoid operated valves supplying gas into the mRPC chambers. When their solenoids are energized, the valves OPEN. All valves can be manually switched ON or OFF, simultaneously, from the gas valve control station (Gas Mixing Panel – GMP) located outside the tent as long as the safety faults are reset. The valves are simultaneously switched OFF, automatically, if the Safety System detects a fault.

Bypass Box

Each trip channel is provided with a Bypass Switch. Whenever maintenance or calibration of the instrumentation is performed, the channel can be placed in bypass, thereby preventing trip actions until the activity is completed. The phone dialer's inputs can also be bypassed to prevent nuisance alarms during maintenance. The Bypass Switch box is located on the wall adjacent to the safety system rack.

The Bypass Box front door is equipped with a lockable handle. It uses the same key that is used for the PHENIX Safety System Bypass Box. During normal operation the box will be locked by the CAS Watch Shift. They remain in possession of the key as is the case for PHENIX Safety System Bypass Box.

Fire Alarm Zone 11

mRPC Safety Channel 1

The mRPC Tent contains nine (9) photo-electric smoke detectors mounted on its ceiling. Their type, location, and spacing were approved by the BNL Fire Protection Engineer. The detectors are wired as a single zone and connected into the AGS building fire alarm panel zone 11. The fire panel's output relay contact for that zone connects to mRPC Safety Channel input 1.

Flammable Gas Detector

mRPC Safety Channel 2

A flammable gas monitor controller is matched with catalytic bead type sensors to make up the mRPC Facility flammable gas detection system. The sensors will respond to isobutane which is part of the three gas mixture for the mRPC chambers. The controller is a SmartMax II manufactured by Control Instruments Corporation. It is capable of reading up to four externally mounted sensors.

Three sensors will be used. Two sensors will be inside the tent, located on the Cosmic Ray Test Stand and Dark Current Test Stand, a few inches above floor level. The other sensor is outside the tent, located near the Gas mixing rack along the shield block wall.

Gas Monitor Set Points:

The Gas Controller alarm outputs will be set to respond at the following values. They are: LOW LEVEL ALARM = 5% full scale. HIGH LEVEL ALARM = 15% full scale. The controller also has a malfunction alarm output.

The low level and malfunction outputs are connected into the phone dialer alarm unit. The high level output triggers the Safety System channel 2.

The SmartMax System is the same type as used in the PHENIX Safety System to monitor the Gas Mixing House. It requires periodic re-calibration using a reference test gas.

SF6 Gas Monitor

mRPC Safety Channel 3

The mRPC Facility is provided with a SenTech SF6-MCD Sulfurhexafluoride monitor. The unit samples ambient air and measures the amount of halogen based gas in the air sample. The monitor has eight sample ports with one reference air (fresh air inlet) port and one exhaust port. A small diaphragm pump pulls sample air into the ports (one at a time), through a filter, into an infrared sensor, and out the exhaust port. Plastic tubing (¼ inch dia.) extends from the monitor ports to the various sensing areas located inside & outside the mRPC tent.

Sensitivity to Refrigerants: The system is sensitive in varying amounts to many ozone depleting substances, including some of the halogen-based refrigerants, those containing molecules of fluorine, chlorine, or both. The sensor in the SF6-MCD has been selected to respond primarily to sulfurhexafluoride.

Test Lab Calibration: The monitor is calibrated at the test lab prior to shipment. The system maintains accuracy through automatic re-zeroing. Periodically, the

system switches to the fresh air inlet, and reestablishes a reference signal to which it compares sample air. This process eliminates the potential variations caused by changes that develop in electronics as components age. If a change in infrared energy or detection of the infrared energy develops, that change will be first measured in the reference signal, then also in the sample. The PPM level is based on the ratio of the sample to the reference. This ratio eliminates the effect of any variations, and eliminates the need to periodically calibrate the monitor.

The low level and malfunction outputs are connected into the phone dialer alarm inputs .

The high level output triggers the Safety System channel 3.

Emergency-Stop “Crash” Push buttons

mRPC Safety Channel 4

There are three crash push button stations. Two stations are located inside the tent and one is at the mRPC Safety System Rack. Each push button will trip safety channel 4 and initiate electric power shutdown and closure of the gas valves. The buttons will lock in the (down) ‘pushed’ position and require a person to manually twist them in order to reset them (spring return to up) to normal.

Rack Automatic Phone Dialer

The mRPC Safety System rack is connected to the BNL phone system via an analog line. The line terminates into an Omega “OMA-GUARD IT” phone dialer and a locally connected touchtone phone (mounted inside the rack) is used to load message recordings into it. These messages are activated by the safety system logic and sent to pre-programmed cell/home/pagers/BNL telephone numbers.

OMA-GUARD-IT Unit:

The Guard-it alarm auto dialer has a four input channel capability. Using a programming phone at the front panel, the user may pre-record voice messages up to 12 seconds in length for each channel. Eight phone numbers can be called. After receiving the alarm message, a person can acknowledge the alarm by pressing the “9” key on the phone. Acknowledgement will stop the dialer from calling the next phone number on the list. The auto dialer can also be remotely called and it will

answer. A system expert can then acknowledge alarms or check the health status of the unit.

It is intended that the only group authorized to acknowledge the phone alarms is the same group responsible for alarm response. Alarm response requires person(s) to report at the mRPC Facility to assess the conditions and call for the assistance of system experts, if necessary.

Rack Uninterruptible Power Supply

The rack contains an APC 3KW UPS system capable of powering the rack and peripheral instruments in the event that normal AGS building 912 power is lost. The estimated “ride through” time is expected to be well over one hour. This will increase the reliability and availability of the safety system. Power (120 volt AC) for the Safety System control circuit’s 24 volt DC power supply is delivered by the UPS. Therefore, following a long outage, the UPS batteries will expire, control power will be lost, all trip channel relays will drop out and the main contactor will drop out (tent power goes off & gas valves close). Also, the phone dialer will lose its capability to make outgoing alarm message calls.

The UPS does not deliver any 120 volt power to equipment inside the tent.

However, UPS 24 volt (low current) control power will exist on the crash button circuit following a safety trip. Also, the flammable gas monitor’s sensor power remains ON.

Procedure

2.0 Prerequisites

- 2.1 Calibrate/configure the flammable gas monitor to detect levels of Isobutane. Perform calibration in accordance with the SmartMax II instruction manual #H7SMX081 Rev. B, pages 13,14 and 15. Configure the low alarm set point to 5% LFL and the high alarm trip set point to 15% LFL.
- 2.2 The Sulfurhexafluoride (SF₆) gas monitor is test lab calibrated. Configure the alarm set points as follows: Low alarm = 50 ppm, main alarm = 100 ppm, high alarm = 150 ppm.

- 2.3 The BNL Fire/Rescue Group shall test the mRPC facility fire alarm zone 11 smoke sensors for proper operation. Obtain documentation verifying that a zone 11 alarm will sound the bldg. 911 evacuation bells/strobes, trip the mRPC Safety System fire alarm channel and report the zone trip in the BNL Fire Alarm Control Panel (FACP). Attach the document to this test procedure.

3.0 Local Trip and Alarm Channel Tests

Note: The following steps for each trip test section described below should be performed in order. The tests will be conducted using the local instrumentation installed in the vicinity of the mRPC Tent facility. The indicators and controls are located inside/outside the tent. Panel mounted devices are contained on the mRPC Safety System Rack (mRPC-SS-R) and the Gas Mixing Panel (GMP) (located in the corridor outside the tent).

3.1 Fire Alarm zone 11 trip test

- 3.1.1 Trip Fire Alarm Zone 11 and verify the following conditions exist on the mRPC-SS-R:

- 3.1.1.1 The fire alarm trip indicator light is flashing.
- 3.1.1.2 The master trip signal indicator light is on.
- 3.1.1.3 The alarm sounder is reporting.
- 3.1.1.4 The Main Power Contactor “ON” light is “off” and the contactor “OFF” light is “on”.
- 3.1.1.5 The alarm sounder stops reporting after pressing the “alarm silence” button.

- 3.1.2 Verify the following conditions exist on the GMP:

- 3.1.2.1 The fault light is on.
- 3.1.2.2 All three solenoid operated gas valves (isobutane, SF6, Freon) are de-energized – closed.

Electrical power and gas flow to the mRPC tent facility is now OFF.

- 3.1.3 Reset the fire alarm zone 11 trip. Verify the following conditions exist on the mRPC-SS-R:
 - 3.1.3.1 The fire alarm trip indicator light turns off after pushing its reset button.
 - 3.1.3.2 The master trip signal indicator light turns off after pushing its reset button.
 - 3.1.3.3 The Main Contactor energizes after turning its switch to the ON position. The contactor “ON” light is “on” and the contactor “OFF” light is “off”.
- 3.1.4 Reset the fault light on the GMP and verify the following conditions:
 - 3.1.4.1 The fault light turns off.
 - 3.1.4.2 All three solenoid operated gas valves are energized – open after pressing the ‘power to valves” switch ON.

Electrical power and gas flow to the mRPC tent facility is now restored ON.

3.2 Flammable Gas trip test

- 3.2.1 Trip the isobutane gas channel via admitting a flammable gas sample to each gas sensor and verify the following conditions exist:
 - 3.2.1.1 The isobutane alarm trip indicator light is flashing on the mRPC-SS-R.
 - 3.2.1.2 The master trip signal indicator light is “on” on the mRPC-SS-R.
 - 3.2.1.3 The alarm sounder is reporting on the mRPC-SS-R.
 - 3.2.1.4 The **Yellow** alarm strobes/horns inside the tent and outside the tent are reporting.

- 3.2.1.5 The Main Power Contactor “ON” light is “off” and the contactor “OFF” light is “on” on the mRPC-SS-R.
- 3.2.1.6 The alarm sounder on the mRPC-SS-R and the **yellow** strobes/horns stop reporting after pressing the “alarm silence” button.

3.2.2 Verify the following conditions exist on the GMP:

- 3.2.2.1 Electrical power to the panel (via the power outlet box) is OFF.
- 3.2.2.2 All three solenoid operated gas valves (isobutane, SF6, Freon) are de-energized – closed.

Electrical power and gas flow to the mRPC tent facility is now OFF.

3.2.3 Reset the isobutane gas channel trip. Verify the following conditions exist on the mRPC-SS-R:

- 3.2.3.1 The isobutane gas channel trip indicator light turns off after pushing its reset button.
- 3.2.3.2 The master trip signal indicator light turns off after pushing its reset button.
- 3.2.3.3 The Main Contactor energizes after turning its switch to the ON position. The contactor “ON” light is on and the contactor “OFF” light is off.

3.2.4 Reset the fault light on the GMP and verify the following conditions:

- 3.2.4.1 The fault light turns off.
- 3.2.4.2 All three solenoid operated gas valves are energized – open after pressing the ‘power to valves’ switch ON.
- 3.2.4.3 Electrical power (120VAC is now restored to the outlet box.

Electrical power and gas flow to the mRPC tent facility is now restored ON.

3.3 SF6 Gas trip test

3.3.1 Trip the SF6 gas channel via admitting a R134A Freon or SF6 gas sample to each of the eight gas sensor ports and verify the following conditions exist:

- 3.3.1.1 The SF6 gas high level trip indicator light is flashing on the mRPC-SS-R.
- 3.3.1.2 The alarm sounder is reporting on the mRPC-SS-R.
- 3.3.1.3 The **Blue** alarm strobes/horns inside the tent and outside the tent are reporting.
- 3.3.1.4 The alarm sounder on the mRPC-SS-R and the **Blue** strobes/horns stop reporting after pressing the “alarm silence” button.

3.3.2 Verify the following conditions exist on GMP:

- 3.3.2.1 The fault light is ON.
- 3.3.2.2 All three solenoid operated gas valves (isobutane, SF6, Freon) are de-energized – closed.

Electrical power remains ON and gas flow to the mRPC tent facility is now OFF.

3.3.3 Reset the SF6 high level gas channel trip. Verify the following conditions exist on the mRPC-SS-R:

- 3.3.3.1 The isobutane gas high level gas channel trip indicator light turns off after pushing its reset button.

3.3.4 Reset the fault light on the GMP and verify the following conditions:

- 3.3.4.1 The fault light turns off.

- 3.3.4.2 All three solenoid operated gas valves are energized – open after pressing the ‘power to valves’ switch ON.

Gas flow to the mRPC tent facility is now restored ON.

3.4 Emergency Stop (crash) push button trip test

- 3.4.1 Push each of the three crash buttons, one at a time, (two inside the tent and one on the mRPC-SS-R) and verify the following conditions exist on the mRPC-SS-R:

- 3.4.1.1 The E-stop trip indicator light is flashing.
- 3.4.1.2 The trip signal indicator light is on.
- 3.4.1.3 The alarm sounder is reporting.
- 3.4.1.4 The Main Power Contactor “ON” light is “off” and the contactor “OFF” light is “on”.
- 3.4.1.5 The alarm sounder stops reporting after pressing the “alarm silence” button.

- 3.4.2 Verify the following conditions exist on the GMP:

- 3.4.2.1 The fault light is on.
- 3.4.2.2 All three solenoid operated gas valves (isobutane, SF6, Freon) are de-energized – closed.

Electrical power and gas flow to the mRPC tent facility is now OFF.

- 3.4.3 Reset the crash button trip. Verify the following conditions exist on the mRPC-SS-R:

- 3.4.3.1 The crash button trip indicator light turns off immediately when the crash buttons are reset.
- 3.4.3.2 The trip signal indicator light turns off after pushing its reset button.

3.4.3.3 The Main Contactor energizes after turning its switch to the ON position. The contactor “ON” light is “on” and the contactor “OFF” light is “off”.

3.4.4 Reset the fault light on the GMP and verify the following conditions:

3.4.4.1 The fault light turns off.

3.4.4.2 All three solenoid operated gas valves are energized – open after pressing the ‘power to valves’ switch ON.

Electrical power and gas flow to the mRPC tent facility is now restored ON.

3.5 Bypass Switch Tests

Note: The bypass switches are contained in the wall mounted enclosure, adjacent to the mRPC-SS-R.

3.5.1 Fire alarm Bypass switch.

3.5.1.1 Place the Fire Alarm bypass switch to the “bypass” position.

3.5.1.2 Trip fire alarm zone 11 input and verify that the channel does not trip.

3.5.1.3 Return the switch to normal.

3.5.2 Flammable Gas alarm bypass switch.

- 3.5.2.1 Place the flammable gas alarm bypass switch to the bypass position.
- 2.5.2.2 Trip the flammable gas channel input and verify the channel does not trip.
- 2.5.2.3 Return the switch to normal.

3.5.3 SF6 alarm Bypass switch.

- 3.5.3.1 Place the SF6 bypass switch to the “bypass” position.
- 3.5.3.2 Trip the SF6 channel input and verify that the channel does not trip.
- 3.5.3.3 Return the switch to normal.

3.5.4 Gas valves trip Bypass switch.

- 3.5.4.1 Place the gas valves trip bypass switch to the “bypass” position.
- 3.5.4.2 Trip the crash button channel and verify that the fault light (on the gas mixing panel) does not turn on. The gas valves remain open.
- 3.5.4.3 Return the switch to normal.

3.5.5 Main contactor Bypass switch.

- 3.5.5.1 Place the main contactor bypass switch to the “bypass” position.
- 3.5.5.2 Trip the crash button channel and verify that the main contactor does not trip off.
- 3.5.5.3 Return the switch to normal.

3.5.6 Phone dialer Bypass switch.

- 3.5.6.1 Place the phone dialer bypass switch to the “bypass” position.
- 3.5.6.2 Trip the flammable gas channel and verify that Phone dialer alarm input 1 is disabled (the input 1 red light does not turn on).

3.5.6.3 Return the switch to normal.

4.0 Remote alarms channel tests

Note: The mRPC Safety System will send alarms to remote locations via the use of an automatic electronic phone dialer unit contained in the mRPC-SS-R. The unit is connected to the BNL phone system through a dedicated analog phone line. It is capable of placing alarm notification telephone calls to personnel, delivering specific pre-recorded messages. The dialer has a four channel input capacity. The alarm receptor phone number for each channel is programmed into the dialer's memory. It will make the calls when the gas monitors' low or high set points are exceeded or if the gas monitors are malfunctioning. If the phone alarm is not answered or acknowledged by a person at the receptor phone, then, the dialer will continue to make alarm calls (indefinitely) to other phone numbers on the dialer's list, until it is acknowledged. For the purposes of this test, only one phone number was programmed into each of the dialer's four input channel's memory. If more than one alarm channel is tripped at the same time, then the dialer sends multiple alarm messages in a single phone call.

The Blue Sheet Test signature/verification card may indicate that the alarms are received at specific phones (CAS Watch Station, Main Control Room, PHENIX Control Room, etc.).

4.1 Phone dialer input channel 1 – **Flammable Gas High Level Detected.**

4.1.1 Trip the Isobutane gas channel via admitting a flammable gas sample to any of the three gas sensors. Verify the following conditions:

- 4.1.1.1 The channel 1 red LED on the dialer is blinking.
- 4.1.1.2 The receptor phone receives a telephone call stating that high level flammable gas has been detected at the mRPC Facility.

4.1.2 After receiving the call, acknowledge the alarm by pressing the “9” key on the phone. Further alarm calls will be suspended by the dialer. Verify the following:

4.1.2.1 The channel 1 red LED on the dialer is solid.

4.1.2.2 After acknowledging and clearing the alarm at the mRPC-SS-R, the channel 1 LED resets and returns to green.

4.2 Phone dialer input channel 2 – **SF6 Gas High Level Detected.**

4.2.1 Trip the SF6 gas channel via admitting a gas sample to any of the eight gas sensor ports. Verify the following conditions:

4.2.1.1 The channel 2 red LED on the dialer is blinking.

4.2.1.2 The receptor phone receives a telephone call stating that high level SF6 gas has been detected at the mRPC Facility.

4.2.2 After receiving the call, acknowledge the alarm by pressing the “9” key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:

4.2.2.1 The channel 2 red LED on the dialer is solid.

After acknowledging and clearing the alarm at the mRPC-SS-R, the channel 2 LED resets and returns to green.

4.3 Phone dialer input channel 3 – **Flammable gas low level or SF6 gas low level detected.**

4.3.1 Trip the flammable gas low level alarm via admitting a flammable gas sample to any of the three gas sensors. Verify the following conditions:

4.3.1.1 The channel 3 red LED on the dialer is blinking.

4.3.2 The receptor phone receives a telephone alarm message stating that low level flammable or SF6 gas has been detected at the mRPC Facility.

4.3.3 After receiving the call, acknowledge the alarm by pressing the “9” key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:

4.3.3.1 The channel 3 red LED on the dialer is solid.
After acknowledging and clearing the alarm at the mRPC-SS-R, the channel 3 LED resets and returns to green.

4.3.4 Trip the SF6 gas channel low level alarm via admitting a gas sample to any of the eight gas sensor ports. Verify the following conditions:

4.3.4.1 The channel 3 red LED on the dialer is blinking.

4.3.4.2 The receptor phone receives a telephone alarm message stating that low level flammable or SF6 gas has been detected at the mRPC Facility.

4.3.5 After receiving the call, acknowledge the alarm by pressing the “9” key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:

4.3.5.1 The channel 3 red LED on the dialer is solid.
After acknowledging and clearing the alarm at the mRPC-SS-R, the channel 3 LED resets and returns to green.

4.4 Phone dialer input channel 4 – **Flammable gas monitor malfunction or SF6 monitor malfunction.**

4.4.1 Trip the flammable gas monitor malfunction alarm. Verify the following conditions:

- 4.4.1.1 The channel 4 red LED on the dialer is blinking.
- 4.4.1.2 The receptor phone receives a telephone alarm message stating that the flammable gas or SF6 monitor at the mRPC Facility is malfunctioning.
- 4.4.2 After receiving the call, acknowledge the alarm by pressing the “9” key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:
 - 4.4.2.1 The channel 4 red LED on the dialer is solid.
After acknowledging and clearing the alarm at the mRPC-SS-R, the channel 4 LED resets and returns to green.
- 4.4.3 Trip the SF6 gas monitor malfunction alarm. Verify the following conditions:
 - 4.4.3.1 The channel 4 red LED on the dialer is blinking.
 - 4.4.3.2 The receptor phone receives a telephone alarm message stating that the flammable gas or SF6 monitor is malfunctioning at the mRPC Facility.
- 4.4.4 After receiving the call, acknowledge the alarm by pressing the “9” key on the receptor phone. Further alarm calls will be suspended by the dialer. Verify the following:
 - 4.4.4.1 The channel 4 red LED on the dialer is solid.
After acknowledging and clearing the alarm at the mRPC-SS-R, the channel 4 LED resets and returns to green.

This completes the mRPC Safety System Blue Sheet Certification Test

NOTES:

A CAS Watch walkdown of the tent and equipment is required annually after completion of the mRPC Safety System Blue Sheet Certification Test prior to commencing Test Lab operations.

APPENDICES:

The following Documents are appended to this document:

- A) PHENIX mRPC BLUE SHEET MAINTENANCE AND SAFETY
CHECKOFF LIST FOR APPARATUS EMPLOYING HAZARDOUS GAS
(2 sheets)
- B) mRPC Facility Alarm Response Instructions
- C) CAS Watch Alarm Response
- D) mRPC Test Lab Alarm signs

APPENDIX A
PHENIX mRPC TEST LAB BLUE SHEET
MAINTENANCE AND SAFETY CHECK-OFF LIST FOR
APPARATUS EMPLOYING HAZARDOUS GAS
Proc. No. PP-2.5.5.6-10

SAFETY SYSTEM PARAMETERS TO BE SATISFIED PRIOR TO OPERATION
COMPLETE CHECKED ITEMS

	Initials	Date
Fire detection & protection operational		
Phenix mRPC Tent flammable gas detection system operational		
Phenix mRPC Tent SF6 gas detection system operational		
Warning signs (flammable & SF6 gas)		
UPS operational		
Emergency systems off (crash systems) operational		
All action sheets posted		
Set all bypass settings to normal status		
Alarm reporting system operational		
Automatic & manual safety interlocks operational		
ABOVE ITEMS COMPLETED: DATE: _____ TIME: _____ BY: _____ <div style="text-align: right;">PHENIX Safety System Engineer</div>		
SPECIAL INSTRUCTIONS / COMMENTS		

APPENDIX B

mRPC Facility Alarm Response Instructions

1. Safety System Alarm Channel 1 – FIRE ALARM

1.1 Reason for alarm:

- 1.1.1 Smoke has been detected by any of the nine (9) ceiling mounted photoelectric smoke sensors inside the mRPC Tent.

1.2 Local and remote alarm indications/automatic safety actions:

- 1.2.1 BNL Fire alarm evacuation bells and strobes reporting in the building 912 high bay general area.
- 1.2.2 BNL Fire Alarm Panel #157 indicates a Zone 11 trip.
- 1.2.3 BNL Firehouse alarm activates for building 912 zone 11.
- 1.2.4 The mRPC Safety System Rack audible & visual indicators report a Zone 11 Fire Alarm trip.
- 1.2.5 mRPC electrical power trips off and gas valves close.

1.3 mRPC personnel response:

- 1.3.1 Evacuate the tent and high bay area to locations outside the building.

Do not reenter until cleared by fire department/CAS/system experts.

This is a precautionary evacuation to allow CAS and system

experts to trouble shoot and reset system.

1.4 Emergency personnel response:

- 1.4.1 The BNL Fire/Rescue Group will respond with fire trucks/emergency gear.
Refer to Appendix C for CAS Watch response.

1.5 System Expert Response:

- 1.5.1 Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of trip. Reset local alarm indicators and restore the mRPC equipment to normal.

2. Safety System Alarm Channel 2 – HIGH LEVEL FLAMMABLE GAS (Isobutane) detected.

2.1 Reason for alarm:

- 2.1.1 Flammable gas has been detected (above 15% LFL) inside the tent near the Cosmic ray test stand and/or outside the tent near the Gas Mixing Panel.

2.2 Local and remote alarm indications/automatic safety actions:

- 2.2.1 Evacuation alarm horns/strobes (YELLOW) report inside and outside the tent.
- 2.2.2 The mRPC Safety System Rack audible & visual indicators report a high level flammable gas trip.
- 2.2.3 mRPC electrical power trips off and gas valves close.
- 2.2.4 The Safety System Phone dialer calls the CAS Watch station (dialer alarm #1) telephone and delivers the alarm condition

message.

2.3 mRPC personnel response:

- 2.3.1 Evacuate the tent and high bay area to locations outside the building.

Do not reenter until cleared by fire department/CAS/system experts.

This is a precautionary evacuation to allow CAS and system experts to trouble shoot and reset system.

2.4 Emergency personnel response:

- 2.4.1 Refer to Appendix C for CAS Watch response.

2.5 System Expert Response:

- 2.5.1 Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of trip. Reset local alarm indicators and restore the mRPC equipment to normal.

3. Safety System Alarm Channel 3 – HIGH LEVEL Sulfurhexafluoride (SF₆) GAS detected.

3.1. Reason for alarm:

- 3.1.1. SF₆ gas has been detected (above 150 PPM) inside the tent near the Cosmic ray test stand and/or outside the tent near the Gas Mixing Panel.

3.1.2. Local and remote alarm indications/automatic safety actions:

- 3.1.2.1. Evacuation alarm horns/strobes (BLUE) report inside and outside the tent.

- 3.1.2.2. The mRPC Safety System Rack audible & visual indicators report a high level SF6 trip.
- 3.1.2.3. mRPC electrical power remains ON and gas valves close.
- 3.1.2.4. The Safety System Phone dialer calls the CAS Watch station (dialer alarm #2) telephone and delivers the alarm condition message.

3.2 mRPC personnel response:

- 3.2.1 Evacuate the tent and high bay area to locations outside the building.

Do not reenter until cleared by fire department/CAS/system experts.

This is a precautionary evacuation to allow CAS and system experts to trouble shoot and reset system.

3.3 Emergency personnel response:

- 3.3.1 Refer to Appendix C for CAS Watch response.

3.4 System Expert Response:

- 3.4.1 Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of trip. Reset local alarm indicators and restore the mRPC equipment to normal.

4. Safety System Alarm Channel 4 – Emergency Stop “CRASH” Push buttons pressed.

4.1. Reason for alarm:

4.1.1. Any of the three crash push buttons have been pressed. Two are located inside the tent. The third is on the mRPC Safety System Rack.

4.2. Local and remote alarm indications/automatic safety actions:

4.2.1. The mRPC Safety System Rack audible & visual indicators report an emergency stop trip.

4.3. mRPC personnel response:

4.3.1 Make determination if the emergency action requires further assistance by BNL Fire/rescue. If so, pull the local fire alarm pull station and call 2222.

4.4. Emergency personnel response:

4.4.1. Refer to Appendix C for CAS Watch response.

4.5. System Expert Response:

Following the instructions by emergency personnel for safe re-entry into the area, (if they are present) further evaluate conditions. Reset local alarm indicators and restore the mRPC equipment to normal.

5. Safety System Alarm (alarm only – no trip action) – Low Level Flammable Gas detected.

5.1. Reason for alarm:

5.1.1 Flammable gas has been detected (above 5% LFL) inside the tent near the Cosmic ray test stand and/or outside the tent near the Gas Mixing Panel.

5.2. Local and remote alarm indications/automatic safety actions:

5.2.1. There are no automatic trip actions taken. The Safety System Rack phone dialer places an alarm message (dialer alarm #3) call.

5.3. mRPC personnel response:

5.3.1 There are no audible warnings to the mRPC personnel for low level flammable gas detection.

5.4. Emergency personnel response:

5.4.1. Refer to Appendix C for CAS Watch response.

5.5. System Expert Response:

Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of alarm. Reset local alarm indicators and restore the mRPC equipment to normal.

6. Safety System Alarm (alarm only – no trip action) – Low Level SF6 Gas detected.

6.1 Reason for alarm:

6.1.1 SF6 gas has been detected (above 50 PPM) inside the tent at various areas and/or outside the tent near the Gas Mixing Panel.

6.2 Local and remote alarm indications/automatic safety actions:

6.2.1 There are no automatic trip actions taken. The Safety System Rack phone dialer places an alarm message (alarm #3) call.

6.3 mRPC personnel response:

There are no audible warnings to the mRPC personnel for low level SF6 gas detection.

6.4 Emergency personnel response:

6.4.1 Refer to Appendix C for CAS Watch response.

6.5 System Expert Response:

Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of alarm. Reset local alarm indicators and restore the mRPC equipment to normal.

7. Safety System Alarm (alarm only – no trip action) – Flammable Gas Monitor Malfunction.

7.1 Reason for alarm:

7.1.1 The Flammable Gas Monitor is signaling a malfunction.

7.2 Local and remote alarm indications/automatic safety actions:

7.2.1 There are no automatic trip actions taken. The Safety System Rack phone dialer places an alarm message (dialer alarm #4) call.

7.3 mRPC personnel response:

There are no audible warnings to the mRPC personnel for gas monitor malfunction.

7.4 Emergency personnel response:

7.4.1 Refer to Appendix C for CAS Watch response.

7.5 System Expert Response:

Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of alarm. Reset local alarm indicators and restore the mRPC equipment to normal.

8. Safety System Alarm (alarm only – no trip action) – SF6 Gas Monitor Malfunction.

8.1 Reason for alarm:

8.1.1 The SF6 Gas Monitor is signaling a malfunction.

8.2 Local and remote alarm indications/automatic safety actions:

8.2.1 There are no automatic trip actions taken. The Safety System Rack phone dialer places an alarm message (dialer alarm #4) call.

8.3 mRPC personnel response:

There are no audible warnings to the mRPC personnel for gas monitor malfunction.

8.4 Emergency personnel response:

8.4.1 Refer to Appendix C for CAS Watch response.

8.5 System Expert Response:

Following the instructions by emergency personnel for safe re-entry into the area, further evaluate cause of alarm. Reset local alarm indicators and restore the mRPC equipment to normal.

NOTES:

APPENDIX C

CAS Watch Response to PHENIX mRPC Test Lab Alarms:

1. Fire Alarm (Alarm Channel 1)

- BNL Fire/Rescue Group will respond.
- CAS is notified via its Fire Alarm Panel and/or radio call from Fire Dept.
- Report to the mRPC facility. Notify mRPC system experts using info on posted call out sheet, located on safety system rack and in CAS shop.

2. High Level Flammable Gas Detected (Alarm Channel 2, dialer alarm #1)

- Report to the mRPC Facility, monitor for Isobutane gas (heavier than air) with handheld instrument. Notify BNL Fire Dept. if necessary.
- Silence the alarm horns via pressing the “alarm silence” push button on the mRPC Safety System Rack. (white lights are out on the gas mixing panel and red fault light is on).
- If tent power is ON or the solenoid gas valves are OPEN, then press the emergency off “Crash” push button on the mRPC Safety System Rack.
- Notify mRPC system experts using info on posted call out sheet.
- If gas concentration is greater than 15% LEL: Pull Fire Alarm and evacuate the premises.

3. High Level (SF₆) Gas Detected (Alarm Channel 3, dialer alarm #2)

- Notify mRPC system experts using info on posted call out sheet.

4. Emergency Stop “CRASH” Push buttons pressed. (Alarm Channel 4)

- Report to the mRPC Facility,
- Assess conditions and determine if personnel are injured, notify BNL Fire dept. if necessary.

- Notify mRPC system experts using info on posted call out sheet.

5. Low Level Flammable Gas/SF₆ detected. (Automatic dialer alarm #3)

- Report to the mRPC Facility, monitor for Isobutane gas or SF₆ gas (heavier than air) with handheld instruments. Notify BNL Fire Dept. if necessary.
- There are no automatic shut down actions.
- Notify mRPC system experts using info on posted call out sheet.

6. Flammable Gas/SF₆ Monitor Malfunction. (Automatic dialer alarm #4)

- Report to the mRPC Facility.
- There are no automatic shut down actions.
- Notify mRPC system experts using info on posted call out sheet.
- If a monitor malfunction persists for more than 2 hours, shut off all gas flow until monitoring system is restored to normal operation.

	mRPC SAFETY SYSTEM STATE TABLE								
	FAULT CONDITION	GAS VALVES	MAIN POWER	YELLOW HORN/STROBE	BLUE HORN/STROBE	PHONE ALARM 1	PHONE ALARM 2	PHONE ALARM 3	PHONE ALARM 4
	NORMAL = VALVES OPEN, POWER ON, HORN/STROBES OFF								
High Level Action	1 SMOKE DETECTORS TRIP	CLOSED	OFF	OFF	OFF				
	2 HIGH LEVEL FLAMMABLE GAS	CLOSED	OFF	ON	OFF	X			
	3 HIGH LEVEL SF ₆	CLOSED	ON	OFF	ON		X		
	4 EMERGENCY OFF (CRASH)	CLOSED	OFF	OFF	OFF				
Low Level Action	5 LOW LEVEL GAS	OPEN	ON	OFF	OFF			X	
	6 GAS DETECTOR MALFUNCTION	OPEN	ON	OFF	OFF				X
<p><u>CAS WATCH ADDITIONAL ACTIONS:</u></p> <p>1) IF FLAMMABLE GAS CONCENTRATIONS EXCEED 15% LEL, THEN PULL FIRE ALARMS AND EVACUATE</p> <p>2) CLOSE GAS BOTTLE MANUAL VALVES IF ANY HIGH LEVEL GAS ALARM EXISTS</p>									

APPENDIX D

PHENIX mRPC Test Lab Warning Signs

The following signs are to be posted adjacent to their respective strobe light alarms:

- 1) Adjacent to blue/white strobe light for SF₆ alarm:

CAUTION: SF₆ ALARM

**EVACUATE
WHEN FLASHING**

- 2) Adjacent to yellow/white strobe light for flammable gas:

CAUTION: FLAMMABLE GAS ALARM

**EVACUATE
WHEN FLASHING**